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Nutrition

A Manual for Teachers in Secondary Schools

by

E. W. McHENRY

School of Hygiene, University of Toronto

Issued by Authority of
The Minister of Education
and
The Minister of Health

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FOREWORD

This manual is intended to provide basic information for teaching nutrition as part of a course on health. While it has been specially adapted for adolescent students, the information about nutrition is true for younger children or adults, if adjustments are made for difference in requirements.

The object of teaching nutrition to children is to encourage the formation of proper habits for the choice of food. In the case of secondary school students the reasons for the choice of certain foods should be made clear so that habits may be formed on the basis of an intelligent understanding.

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I. INTRODUCTION

Meaning of Nutrition

The phase of science concerned with the nourishment of the living organism.

Relation of Nutrition to Health and Physical Fitness

Nutrition is an important factor in the maintenance of health, but not the only factor. Improperly nourished children do not grow normally, are more susceptible to infection, and tire easily. Inadequate nutrition, in itself, can cause disease. It is impossible to be healthy unless properly nourished, but an adequately fed person may be poorly nourished because of failure to assimilate food, or lack of rest, or interference with food utilization in the body. Nutrition is part of a health program and not a program in itself.

Relation of Food to Nutrition

To secure nutrition, food is eaten, digested to permit absorption, absorbed, and utilized by the body for a variety of purposes. The primary factor in nutrition is the intake of food.

II. ESSENTIALS OF A FOOD INTAKE FOR ADEQUATE NUTRITION

A food intake is adequate if it provides, in needed amounts, the substances which are essential for the proper functioning of the body. Food should be chosen to satisfy definite physiological requirements.

(a) PHYSIOLOGICAL REQUIREMENTS SATISFIED BY FOODS

1. Growth and repair of tissue.
2. Energy—
   - (i) to maintain activity of vital organs (heart, lungs);
   - (ii) to keep the body warm;
   - (iii) to enable work to be done.
3. Regulation of body processes.
4. Prevention of nutritional diseases.

(b) REQUIREMENTS FOR GROWTH AND REPAIR

During growth, fresh tissue is constructed, and at every age there is a continuous loss which must be replaced. The chief constituents of soft tissues are proteins. Proteins are compounds which always contain nitrogen in addition to carbon, hydrogen and oxygen. There are many different proteins, but all are formed by the union of simple units called *amino acids.* Proteins differ from each other in their content of amino acids.

Two mineral elements, calcium and phosphorus, are required for the formation of bones and teeth (see mineral elements). Practically all of the vitamins are needed for growth (see vitamins).

Adults need at least one gram of protein per day per kilogram of body weight (70 grams for 150-pound man). Children require more protein than do adults in proportion to body weight, and should have 2 to 3 grams per day per kilogram of body weight. (1 kilogram = 2.2 pounds.)

The proteins which occur in foods are built up from varying amounts of eighteen different amino acids. The body can synthesize some of these amino acids, but eight cannot be so made and must be supplied in the diet. Many proteins do not contain all of the essential amino acids. Proteins which supply the essential amino acids are "complete"; deficient proteins are called "incomplete" and have less food value. Animal proteins (in milk, cheese, eggs, meat, fish) are generally complete. Vegetable proteins are generally incomplete. In order that essential amino acids be supplied, 30 to 50 per cent of the protein eaten should be animal in origin.

Nutritional Protein Value of Some Common Foods

FOOD	PROTEIN QUALITY	SIZE OF AVERAGE SERVING	AMOUNT OF PROTEIN IN AVERAGE SERVING
Milk	Complete	6-oz. glass	6 grams
Cheese	Complete	1-inch cube	6 grams
Egg	Complete	1	6 grams
Beef, medium fat	Complete	1 slice	15 grams
Bread	Incomplete	1 slice	3 grams
Baked beans	Incomplete	3 tbsp.	8 grams

(c) ENERGY REQUIREMENTS

Energy is required to maintain activity of vital organs, to keep the body warm, and to enable work to be done. The first two demands are continuous throughout life. The amount of energy required to satisfy the first two demands is influenced by body area (depending on weight and height), by age, and by sex. The energy requirement for work varies directly as the severity of the work.

Energy is produced by the oxidation of foodstuffs in the body and is conveniently measured in heat units (1 calorie = amount of heat required to raise the temperature of 1 kg. of water 1° C.).

Accepted Values for Energy Requirements

Man—moderately active	3000 cal.
very active	4500 "
sedentary	2500 "
Woman—moderately active	2500 "
very active	3000 "
sedentary	2100 "

Children— 4– 6 years	1600 cal.
7– 9 years	2000 "
10–12 years	2500 "
Girls—13–15 years	2800 "
16–20 years	2400 "
Boys—13–15 years	3200 "
16–20 years	3800 "

Three classes of food constituents are oxidized to give energy:

Fats . . . most concentrated source of energy.

Carbohydrate (sugar and starch) . . . cheapest source of energy.

Protein . . . also required for growth and repair.

In Canada, people generally secure 10 to 12 per cent of total food energy from protein, about 40 per cent from fat, and about 50 per cent from carbohydrate.

Energy Values of Some Common Foods

Food	Size of Average Serving	Energy Value (Calories)
Milk	6-oz. glass	157
Butter	1-inch square	77
Cheese	1-inch cube	87
Eggs	1	83
Beef, medium fat	1 slice	138
Bread	1 slice	80
Oatmeal, cooked	½ cup	50

(d) REQUIREMENTS FOR MINERAL ELEMENTS

The body needs about thirty chemical elements. Protein, fats and carbohydrates supply carbon, hydrogen, nitrogen, and occasionally sulphur and phosphorus. Other needed elements are required in small amounts and are present in foods in small amounts. These are referred to as "mineral elements." All are essential, but attention is generally given to three, because these are likely to be deficient in ordinary dietaries. The three are calcium, iron, and iodine.

1. **Calcium,** needed with phosphorus for the formation of bones and teeth. Calcium in blood and other body fluids is necessary for normal functioning of nerves. Vitamin D (see vitamins) is essential for proper absorption and utilization of calcium. Requirements for calcium are markedly increased during growth.

Requirements for Calcium

Children—up to 9 years	1.0 gram per day
10 to 12 years	1.2 " " "
Girls—13 to 15 years	1.3 " " "
16 to 20 years	1.0 " " "
Boys—13 to 20 years	1.4 " " "
Adults	0.8 " " "

Food Sources of Calcium

Excellent: milk and cheese.

Good: cauliflower, dried peas and beans, carrots, spinach, oranges.

Milk and cheese contain much more calcium than any other food. It is impossible to secure an adequate supply of calcium from foods unless either, or both, of these foods are used generously. One 6-oz. glass of milk contains

0.2 grams calcium. One pint of milk supplies 0.7 grams calcium. One 1-inch cube of cheese contains 0.2 grams calcium. Skim milk and chocolate dairy drink have the same calcium content as has whole milk; the latter has food value not possessed by the former and is preferable.

2. **Iron** is required for the formation of the red blood pigment, hæmoglobin. Red blood cells, containing hæmoglobin, are constantly being destroyed and new hæmoglobin must be synthesized in the body. For this purpose iron must be supplied in the diet. Nutritional anæmia results from a lack of dietary iron.

Requirements for Iron

Children— 7 to 9 years	10	milligrams
10 to 12 years	12	"
Adolescents—girls and boys	15	"
Adults	12	"

Foods to Give 15 Milligrams of Iron

1 slice roast beef	4.0	milligrams
1 egg	3.1	"
1 serving cabbage	1.8	"
6 slices whole wheat bread	3.1	"
1 serving oatmeal	1.4	"
1 serving potatoes	0.9	"
1 glass tomato juice	0.7	"

Other good sources of iron: prunes, apricots, dark brown molasses, spinach, liver.

3. **Iodine.** The rate of oxidation of foodstuffs in the body is controlled by thyroxin, a compound prepared in the thyroid gland. Iodine is essential for the synthesis of thyroxin. If the intake of iodine is inadequate, the thyroid gland is called upon to do extra work; it enlarges, and simple goitre results. In many districts the iodine content of the soil is low; drinking water and foods produced in such districts contain little iodine. Foods grown in inland districts, such as Ontario, are not dependable sources of iodine. Seafoods are excellent sources of iodine. The most convenient way to secure adequate amounts of iodine is to use iodized salt. The regular use of iodized salt is not harmful and should be encouraged in Ontario.

(e) REQUIREMENTS FOR VITAMINS

A vitamin is an organic food constituent, essential for life, but needed only in very small quantity. Absence of any one of the vitamins from the diet results in impaired growth and health, and even in specific disease. About twenty vitamins have been described and, of these, eight, at least, are essential in human nutrition. Acute vitamin deficiency diseases are rare in Canada. Frequently, however, diets are consumed which contain sufficient of the vitamins to prevent specific diseases but not enough for health. It is estimated that half the population of Canada need more vitamins. These should be obtained, whenever possible, from foods.

Vitamin A

Effects of Deficiency

1. Decreased growth.
2. Lowered health of the mucous membranes (moist linings of mouth, nose, etc.) and hence decreased resistance to infection. Xerophthalmia (a disease of the eye).
3. Dry eyes; dry and abnormal skin.
4. Delayed regeneration of the visual purple of the eyes; slow recovery from bright light; poor vision in subdued light. Night-blindness.

Requirements per day

Children— 7 to 9 years	3500 units
10 to 12 years	4500 "
Adolescents and adults	5000 "

Food Sources

The following foods will give approximately 5000 units:

1½ pints milk	1300 units
1 oz. cheese	700 "
Butter (for 6 slices bread)	800 "
1 serving cabbage	1200 "
1 egg	500 "
1 serving tomato juice	400 "

NOTE:

1 serving beef liver	4500 "
1 serving carrots	2100 "

Green-leaf (cabbage) and yellow (carrots) vegetables are excellent, cheap sources of vitamin A and should be used often.

B Vitamins

A group of about eight vitamins, four of which are essential for human beings. Only two will be discussed: thiamin and riboflavin.

Thiamin, or Vitamin B_1

Effects of Deficiency

1. Decreased growth.
2. Fatigue, irritability, apathy.
3. Neuritis, leading to paralysis. Beriberi (a disease not seen in Canada).
4. Mental depression.
5. Failure to use carbohydrates properly in the body.
6. Loss of appetite.

Requirements per Day

Children— 7 to 9 years	1.0	milligrams
10 to 12 years	1.2	“
Girls—13 to 15 years	1.4	“
16 to 20 years	1.2	“
Boys—13 to 15 years	1.6	“
16 to 20 years	2.0	“
Adults	1.2–2.3	“

Food Sources

The following foods will give 1.6 milligrams:

1½ pints milk	0.51	milligram
6 slices whole wheat bread	0.55	“
1 slice roast beef	0.12	“
1 serving oatmeal	0.18	“
1 glass tomato juice	0.08	“
1 egg	0.08	“
1 serving potatoes	0.06	“

NOTE:

1 slice ham	0.80	“

Thiamin is water-soluble and, therefore, there may be serious loss in cooking water. The amount of cooking water should be the least that will give a palatable product and, after cooking, the water should be used in soups, gravies, etc. Heat destroys thiamin, and loss from heat in cooking may be 10 to 40 per cent, depending on the food.

Riboflavin (sometimes called Vitamin B_2)

Effects of Deficiency

1. Decreased growth.
2. Sores at corners of mouth.
3. Inflammation of the cornea of the eyes. Sensitivity of eyes to bright light.

Requirements per Day

Children— 7 to 9 years	1.5	milligrams
10 to 12 years	1.8	“
Girls—13 to 15 years	2.0	“
16 to 20 years	1.8	“
Boys—13 to 15 years	2.4	“
16 to 20 years	3.0	“
Adults	1.8–3.3	“

Food Sources

The following foods will give 2.4 milligrams:

1½ pints milk	1.8 milligrams
6 slices whole wheat bread	0.2 "
1 egg	0.2 "
1 slice roast beef	0.2 "

NOTE:

1 serving pork liver	1.8 "

Riboflavin is water-soluble and serious loss may occur in cooking water. It is not destroyed by heat, but is destroyed by light. Do not leave bottles of milk in sunlight.

Ascorbic Acid, or Vitamin C

Effects of Deficiency

1. Poor formation and maintenance of teeth and bones.
2. Scurvy, a disease of bleeding gums, hæmorrhages in various parts of body due to weakening of blood vessel walls.
3. Poor growth.

Requirements per Day

Children— 7 to 9 years	60 milligrams
10 to 12 years	75 "
Girls—13 to 20 years	80 "
Boys—13 to 15 years	90 "
16 to 20 years	100 "
Adults	75 "

Food Sources

The following foods will give about 100 milligrams:

1 glass (4 oz.) tomato juice	20 milligrams
1 serving cabbage	15 "
1 serving potatoes	10 "
1 glass (4 oz.) orange or grapefruit juice	50 "

Ascorbic acid is destroyed rapidly in food exposed to air, even at room temperature. It is water-soluble and there is likely to be serious loss in cooking water. Loss from heating may be 40 per cent or more. Use raw fruits and vegetables whenever possible. In cooking fruits and vegetables use as little water as possible and reduce the time to the least that will give a palatable product.

Vitamin D

Effects of Deficiency

1. Rickets: faulty formation of bones due to poor utilization of calcium and phosphorus.
2. Softening of bones in adults.
3. Some relation to tooth decay.

Requirements per Day

Children	400 to 800 units
Adults	not known, but presumed to be necessary

Food Sources

Foods, in general, are poor and unreliable sources of this vitamin. Some may be obtained from canned sea foods, eggs, irradiated milk. Fish-liver oils, sometimes with added synthetic material, are needed supplements for children.

Exposure of skin to sunlight causes formation of vitamin D in the body. While this is the natural method of securing vitamin D it is difficult to obtain sufficient in this way in Ontario. Growing children should receive a supply of vitamin D, such as from cod liver oil, in winter months.

III. DIETARY DEFICIENCIES IN CANADA

In the past four years six extensive surveys have been made on urban groups in Halifax, Quebec, Toronto and Edmonton. They all show that Canadians in various parts of the country are consuming less than the minimum standards required for good nutrition. Typical data are available from a recent survey of students in an Ontario collegiate institute.

Percentage of Students Having Marked Dietary Deficiencies

	Girls	Boys	Total
Calories	3%	7%	5%
Protein	1	2	2
Calcium	13	15	14
Iron	15	0	9
Vitamin A	0	5	2
Thiamin	40	80	55
Riboflavin	16	29	21
Ascorbic acid	72	88	78

It will be noted that the principal deficiencies are of minerals and vitamins, particularly the latter. All urban surveys made in Canada show similar results, except that lack of calcium and iron is more marked among adults. The chief dietary deficiencies in Canada are of minerals (calcium and iron) and of vitamins.

Causes of Dietary Deficiencies in Canada

Three main causes:

1. Economic factors.
2. Ignorance.
3. Indifference.

Prevention of Dietary Deficiencies in Canada

While little can be done about the first cause of malnutrition by our educational system, a great deal can be done about the second and third. Three types of education about nutrition are needed.

1. Formation of good food habits in childhood, coupled with the gradual training of students about the basic principles of nutrition so that the reasons for a wise choice of foods can be understood. This should be done as part of a health course, since proper nutrition is one factor in the maintenance of health.

2. Economical purchasing of foods. This is particularly important for low-income families. Information about this and the third type can be given along with other nutrition instruction and especially in household science classes.

3. Good cooking methods to make food attractive and to prevent undue impairment of nutrition value.

IV. POINTS OF EMPHASIS IN TEACHING NUTRITION

1. Nutrition is one of the factors which influence health. Adequate nutrition alone will not ensure health, but it is essential for health and physical fitness.

2. The principal dietary deficiencies in Canada are of minerals and vitamins. Canadians should alter their choice of foods to include in the diet every day those foods which are good sources of minerals and vitamins. Such foods are called "protective." The protective foods are: milk, cheese, butter, eggs, meat, whole grain cereal products, fruits and vegetables. These foods should be the basis of the day's diet.

Nutritional Requirements of Adolescents (13-15)

	Girls	Boys
Calories	2800	3200
Protein	80 grams	85 grams
Calcium	1.3 grams	1.4 grams
Iron	15 mg.	15 mg.
Vitamin A	5000 units	5000 units
Thiamin (B_1)	1.4 mg.	1.6 mg.
Riboflavin	2.0 mg.	2.4 mg.
Ascorbic acid (C)	80 mg.	90 mg.

Foods to Give Adequate Nutrition for Adolescents (13-15)

The quantities given are desirable per day:

1½ pints milk.

1 oz. cheese.

1 slice roast beef or other meat or fish.

1 serving potatoes.

1 serving cabbage or other vegetables.

1 egg.

6 slices whole wheat bread with butter.

1 glass tomato juice.

1 glass orange or grapefruit juice.

For vitamin D: irradiated milk or 1 tsp. cod liver oil.

Any other desired foods to satisfy appetite.

The list of specific protective foods, above, supplies all minerals and vitamins and has a caloric value of 2200. This is below the total calorie requirement of adolescent girls and boys, and other foods may be used to complete the requirement and to satisfy appetite.